भारतीय मानक
Indian Standard

IS 17055 (Part 13) : 2020

मृदा-संचालन मशीनरी — सुरक्षा

भाग 13 रोलर्स की अपेक्षाएँ

(दूसरा पुनरीक्षण)

Earth-Moving Machinery — Safety

Part 13 Requirements for Rollers

(Second Revision)

ICS 53.100

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Material Handling Systems and Equipment Sectional Committee, MED 07

FOREWORD

This Indian Standard (Part 13) (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Material Handling Systems and Equipment Sectional Committee had been approved by the Mechanical Engineering Division Council.

This standard supersedes the IS 17055 (Part 13) : 2019/ISO 20474-13 : 2017 'Earth moving machinery — Safety: Part 13 Requirements for rollers'.

This Indian Standard is published in several parts. The other parts in this series are:

Part 1	General requirements
Part 2	Requirements for tractor dozers
Part 3	Requirements for loaders
Part 4	Requirements for backhoe loaders
Part 5	Requirements for hydraulic excavators
Part 6	Requirements for dumpers
Part 7	Requirements for scrapers
Part 8	Requirements for graders
Part 9	Requirements for pipelayers
Part 10	Requirements for trenchers
Part 11	Requirements for earth and landfill compactors
Part 12	Requirements for cable excavators

The composition of the Committee responsible for the formulation of this standard is given in Annex D.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

EARTH-MOVING MACHINERY — SAFETY

PART 13 REQUIREMENTS FOR ROLLERS

(Second Revision)

1 SCOPE

This standard (Part 13) specifies the safety requirements of rollers as defined in IS/ISO 6165. It is intended to be used in conjunction with IS 17055 (Part 1), which specifies general safety requirements common to two or more earth-moving machine families. The specific requirements given in this standard take precedence over the general requirements of IS 17055 (Part 1).

1.1 This standard deals with all significant hazards, hazardous situations and events relevant to the earthmoving machinery within its scope [*see* IS 17055 (Part 1), Annex A] when used as intended or under conditions of misuse reasonably foreseeable by the manufacturer. It specifies the appropriate technical measures for eliminating or reducing risks arising from relevant hazards, hazardous situations or events during commissioning, operation and maintenance.

2 REFERENCES

The standards listed below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of these standards indicated below:

IS No./Other Publication	*Title*
16479 : 2017	Performance requirements and test procedures of braking systems for wheeled high speed rubber tracked earth moving machines and construction equipment vehicles
IS/ISO 6165 : 2012	Earth-moving machinery — Basic types — Identification and terms and definitions
11252 : 1993/ ISO 6682 : 1986	Earth-moving machinery — Zones of comfort and reach for controls
IS/ISO 17063 : 2003	Earth-moving machinery — Braking systems of pedestrian-controlled machines — Performance requirements and test procedures
17055 (Part 1) : 2018	Earth-moving machinery — Safety: Part 1 General requirements
ISO 3744 : 2010	Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane
IS/ISO 8811 : 2000	Earth-moving machinery — Rollers and compactors — Terminology and commercial specifications
ISO 11201 : 2010	Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections
16818 : 2018/ ISO 13850 : 2015	Safety of machinery — Emergency stop function — Principles for design
ISO 20643 : 2005	Mechanical vibration — Hand-held and hand-guided machinery — Principles for evaluation of vibration emission

3 TERMS AND DEFINITIONS

For the purposes of this standard, the terms and definitions given in IS 17055 (Part 1) and IS/ISO 8811 shall apply in addition to the following.

3.1 Roller — Self-propelled or towed machine having a compaction device, consisting of one or more metallic cylindrical bodies (drums) or rubber tyres, which compacts material, such as crushed rock, earth, asphalt or gravel through a rolling or vibrating action of the compaction device.

NOTE — To entry: The metallic cylindrical bodies can be rubber-coated or fitted with pads.

3.1.1 *Single-drum Roller* — Self-propelled compaction machine with one vibrating metallic cylindrical body (drum) and two rubber tyres or two tracks.

3.1.2 *Tandem Roller* — Self-propelled compaction machine with one metallic cylindrical body (drum) in the front and one in the rear.

NOTE —To entry: The cylindrical drums can be static or vibrating and can be split.

3.1.3 *Combined Roller* — Self-propelled compaction machine with one or more metallic cylindrical body (drum) and more than two rubber tyres.

3.1.4 *Three-wheel Roller* — Self-propelled compaction machine with one metallic cylindrical body (drum) in the front (or rear) and two in the rear (or front).

NOTE — To entry: The drums can be split.

3.1.5 *Pneumatic Tyre Roller* — Self-propelled compaction machine with three or more tyres in the front and the rear.

3.2 Direct-control Machine — Self-propelled earth-moving machinery where the machine is controlled by an operator in physical contact with the machine.

3.2.1 *Ride-on Machine* — Self-propelled direct-control machine (*see* **3.2**) where the control devices are located on the machine and the machine is controlled by a seated or standing operator.

3.2.2 *Non-riding Machine* — Self-propelled direct-control machine (*see* **3.2**) where the control devices are located on the machine and the machine is controlled by a pedestrian operator (neither seated nor standing on the machine).

3.3 Remote-control Machine — Self-propelled earth-moving machinery where the machine is controlled by the transmission of signals from a control box (transmitter) that is not located on the machine to a receiving unit (receiver) located on the machine

3.4 Towed Roller — Roller (*see* **3.1**) that is not self-propelled but which is propelled instead by a towing machine on which the operator station is located

4 SAFETY REQUIREMENTS AND PROTECTIVE MEASURES

4.1 General

Rollers shall comply with the safety requirements and protective measures of IS 17055 (Part 1) in as far as those are not modified by the specific requirements of this clause.

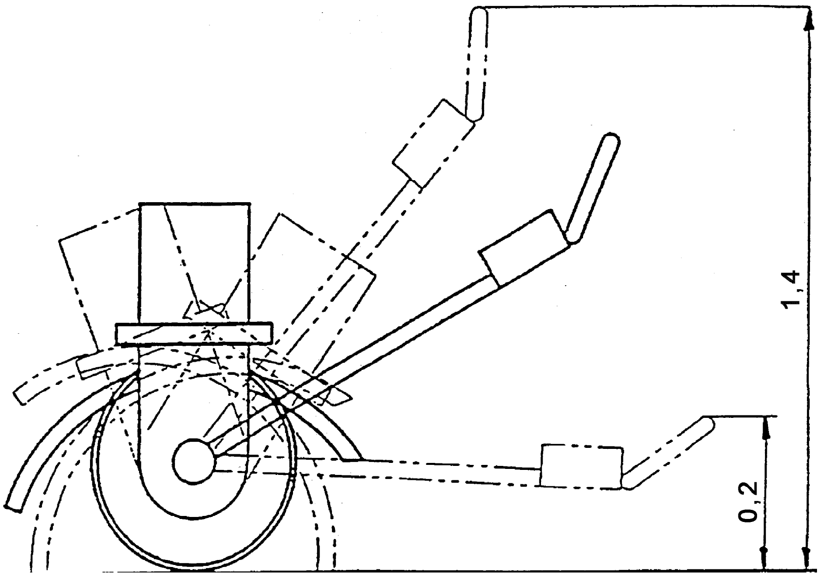
4.2 Non-riding Machines

4.2.1 *General*

Clause **4.1** of IS 17055 (Part 1), shall apply, in addition to the **4.2.2** and **4.2.3**.

4.2.2 *Handle Bar*

To prevent dangerous vertical swinging of the steering element (handle bar) of the single-drum non-riding roller, movement of the handle shall be not less than 0. 2 m and not more than 1. 4 m above the ground (*see* Fig. 1).



Dimensions in metres

FIG. 1 VERTICAL SWINGING OF SINGLE-DRUM NON-RIDING ROLLER

4.2.3 *Protection against Crushing*

Non-riding and remote-control machines shall be provided with protection against crushing that is designed to prevent the operator from being trapped between the machine and an obstacle see Fig. 2.

This device shall be so designed as to stop the machine within a distance that is less than the total operating range of the device.

The stopping device shall have an effective operating force not exceeding 230 N.

4.3 Operator Station (Ride-on Machines)

4.3.1 *General*

Clause **4.3.1** of IS 17055 (Part 1), shall apply, together with the additions and modification given in **4.3.2** to **4.3.4**.

4.3.2 *Operator's Position*

If the operator's position is offset from the space envelope width centerline, then the internal distance from the seat centerline to the side of the enclosure shall not be less than 295 mm.

4.3.3 *Operator's Station with Cab*

The first two paragraphs of **4.3.1.1** , and the whole of **4.3.1.2** of IS 17055 (Part 1), , do not apply to rollers.

Rollers with an operating mass > 4 500 kg shall be so designed that an operator's cab can be fitted.

4.3.4 *Doors and Windows*

Doors and windows latched in open positions shall not extend beyond the main outer dimensions of the machine, when the machine is in operation as intended.

4.4 Operator's Seat

Clause **4.4** of IS 17055 (Part 1), 4shall apply, except for **4.4.1.4** of IS 17055 (Part 1) .

4.5 Controls and Indicators

4.5.1 *General*

Clause **4.5** of IS 17055 (Part 1), shall apply, in addition to the **4.5.2** to **4.5.4**.

4.5.2 *Travel Control of Non-riding Rollers with Handle Bar*

The machine travel control of non-riding rollers with an attended operator shall be of the hold-to-run type for both directions.

4.5.3 *Controls for Towed Machines*

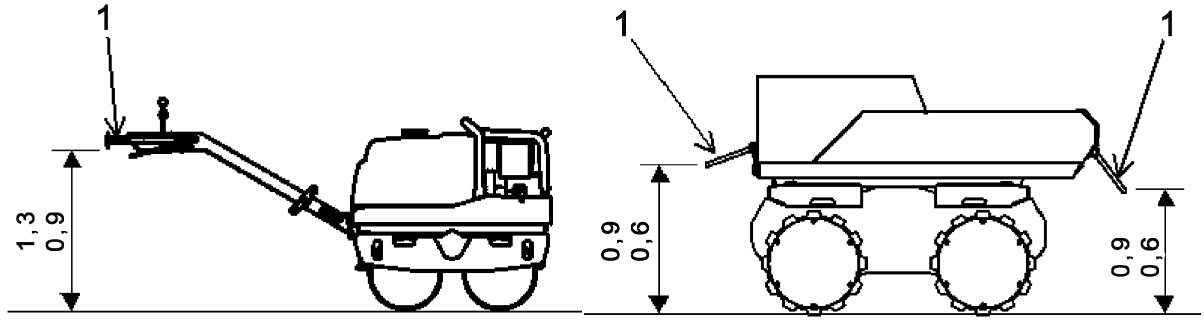
For towed rollers, it shall be possible to control the on-off operation of the vibration from the operator station on the towing machine.

4.5.4 *Brake Systems*

4.5.4.1 *Ride-on machines*

For ride-on rollers **4.7** of IS 17055 (Part 1), shall apply, in addition to the following:

a) The brake system shall be in accordance with IS 16479.
b) For service and secondary brake systems:
    1) the brake system shall apply to all power-driven drums and wheels;
    2) in case of split drums, every drum part shall have the same brake torque; and
    3) the brake systems of single drum rollers and combined rollers shall apply to all wheels and to the drum.
c) Consideration should be given for the performance of the brake system to the intended slopes as foreseen by the manufacturer.
d) All brake systems shall be controlled from the operator station.



a) Roller with handle bar

b)Remote-control roller

Key

Dimensions in metres

1 stopping device

FIG. 2 — POSITION OF CRUSHING PROTECTION (STOPPING DEVICE) ON NON-RIDING AND REMOTE-CONTROL MACHINES

4.5.4.2 *Non-riding machines*

The brake systems of non-riding rollers shall be in accordance with IS/ISO 17063.

4.5.5 *Emergency Stop*

An emergency stop in accordance with IS 16818 shall be fitted within the zone of comfort as specified in IS 11252. It shall stop all hazardous functions of the machine.

4.6 Access System to Operator Station and to Maintenance Points

4.6.1 *General*

Clause **4.2** of IS 17055 (Part 1), shall apply, together with **4.6.2**.

4.6.2 *Guard Rail*

Walkways to the operator station and to platforms shall be provided with guard-rails if the vertical drop exceeds 1 m.

4.7 Vibration

The hand–arm vibration of non-riding rollers with a working width ≤ 1 m shall be determined according to Annex B.

5 INFORMATION FOR USE

5.1 Warning Signals and Devices

Clause **6.1** of IS 17055 (Part 1) shall apply.

5.2 Operator's Manual

Clause **6.2** of IS 17055 (Part 1), shall apply with the following additions:

a) a reference to hand–arm vibration as per **4.7** and Annex B;
b) instruction in the need for a stopping device for non-riding and remote controlled rollers;
c) safety precautions for starting and stopping non-riding rollers;
d) instructions for proper use, including cleaning and maintenance of the water sprinkler system; and
e) additional information concerning the stability of the machine (permissible slope, etc.).

Instructions regarding any other system(s) installed in the machine shall be provided.

5.3 Marking

Clause **6.3** of IS 17055 (Part 1), shall apply.

6 BIS CERTIFICATION MARKING

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

ANNEX A

NOISE-TEST CODE FOR NON-RIDING AND REMOTE-CONTROL VIBRATORY ROLLERS WITH WORKING WIDTH ≤ 1 M

A-1 GENERAL

This noise-test code specifies all the information necessary for carrying out efficiently and under standardized conditions the determination, declaration and verification of the noise-emission characteristics of non-riding and remote-control vibratory rollers with a working width ≤ 1 m.

NOTE — The test track width given here and as described in the noise directive 2000/14/EC does not practically allow measurement of machines with a working width exceeding 1 m, due to random effects from the test track boundary.

Noise-emission characteristics include emission sound-pressure levels at workstations and the sound-power level. The determination of these quantities is necessary for:

a) manufacturers' declarations of the noise emitted,

b) comparing the noise emitted by machines in the machine family concerned, and

c) for noise control at the source at the design stage.

The use of this noise-test code ensures reproducibility of the determination of the noise-emission characteristics within specified limits determined by the grade of accuracy of the basic noise measurement method used. The noise-measurement methods which may be used are engineering methods in accordance with ISO 3744, Grade 2.

Test conditions and procedures for the determination of noise emission (according to this annex) and hand–arm vibration (according to Annex B) are identical. It is therefore possible and recommended to record the noise emission and the hand–arm vibration simultaneously during one measurement. The measuring effort is thereby reduced.

A-2 TEST AREA

A-2.1 Design of Test Site

The test may be carried out outdoors or in an appropriate room. Sound-reflecting material (example, concrete, closed-pore asphalt or steel plates) of at least 10 m × 10 m and a zone of at least 25 m × 25 m with no reflecting obstacles are required around the test track.

A-2.2 Design of Test Track

The test course of gravel shall be designed as shown in Fig. A-1. The compression ground shall have the following characteristics:

a) dry gravel with sufficient hardness of a mean gravel diameter of 16 mm (particle size 10 mm to 22 mm), with a grading curve as shown in Fig. A-2;

b) the gravel shall be replaced if the mean gravel diameter decreases by 30 percent or more;

c) the dumping height of the gravel shall be at least 0.50 m due to the depth effect of the compacting machines; and

d) the test course of gravel shall have the same horizontal level as the sound-reflecting surface being rammed in order to prevent the gravel from creeping.

A-2.3 Measurement Surface

A-2.3.1 *Shape and Size of Measurement Surface*

The measurement surface used for determining the A-weighted sound-power level shall be a hemisphere of radius r = 4 m, bounded by the sound-reflecting surface (*see* Fig. A-3 and A-4).

Dimensions in metres

Fig. A-3 — Arrangement of test positions for direct control non-riding rollers

A-2.3.2 *Microphone Positions*

Six microphone positions are specified on the hemisphere (*see* Fig. A-3, A-4 and Table A-1).

Table A.1 Coordinates of Microphones

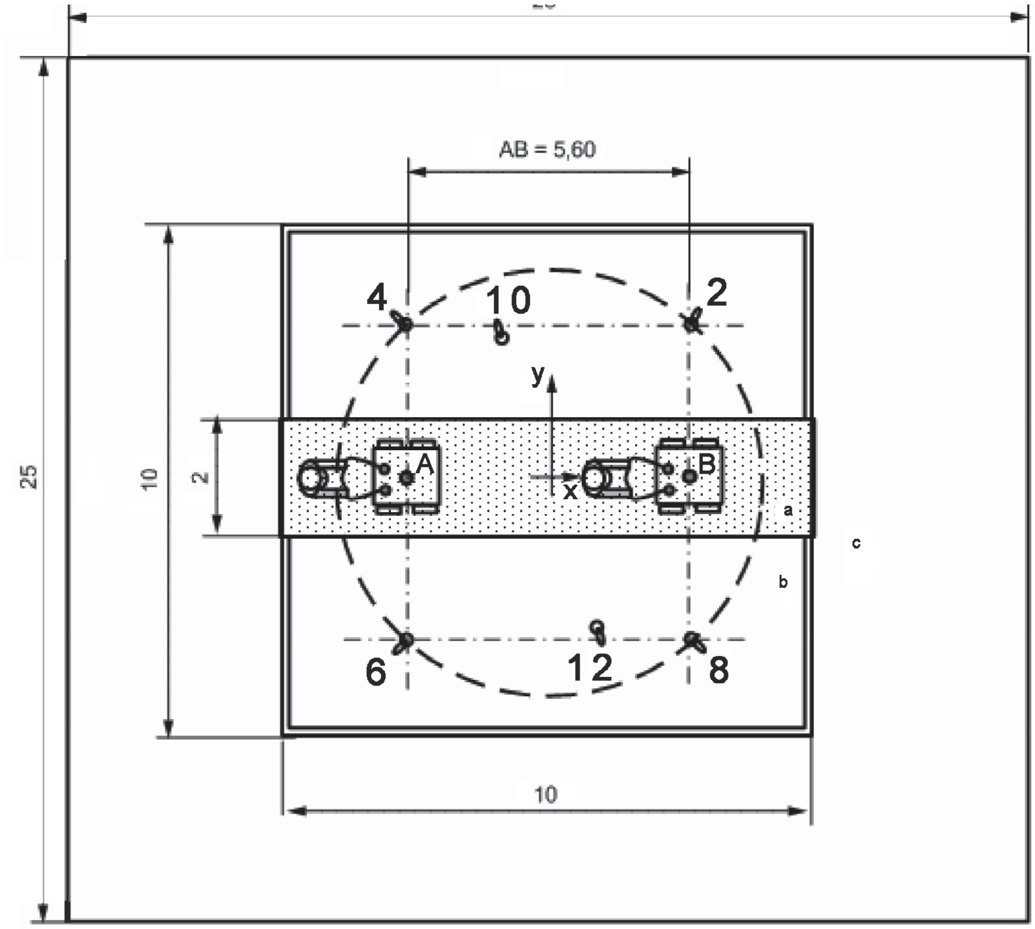
(*Clause* A-2.3.2)

Measuring Point	Coordinates		
	x	*y*	*z*
2	2.8	2.8	1.5
4	-2.8	2.8	1.5
6	-2.8	-2.8	1.5
8	2.8	-2.8	1.5
10	-1.08	2.6	2.84
12	1.08	-2.6	2.84

A-3 DETERMINATION OF A-WEIGHTED SOUND-POWER LEVEL

A-3.1 General

This clause specifies additional requirements for the determination of the A-weighted sound-power level according to ISO 3744.

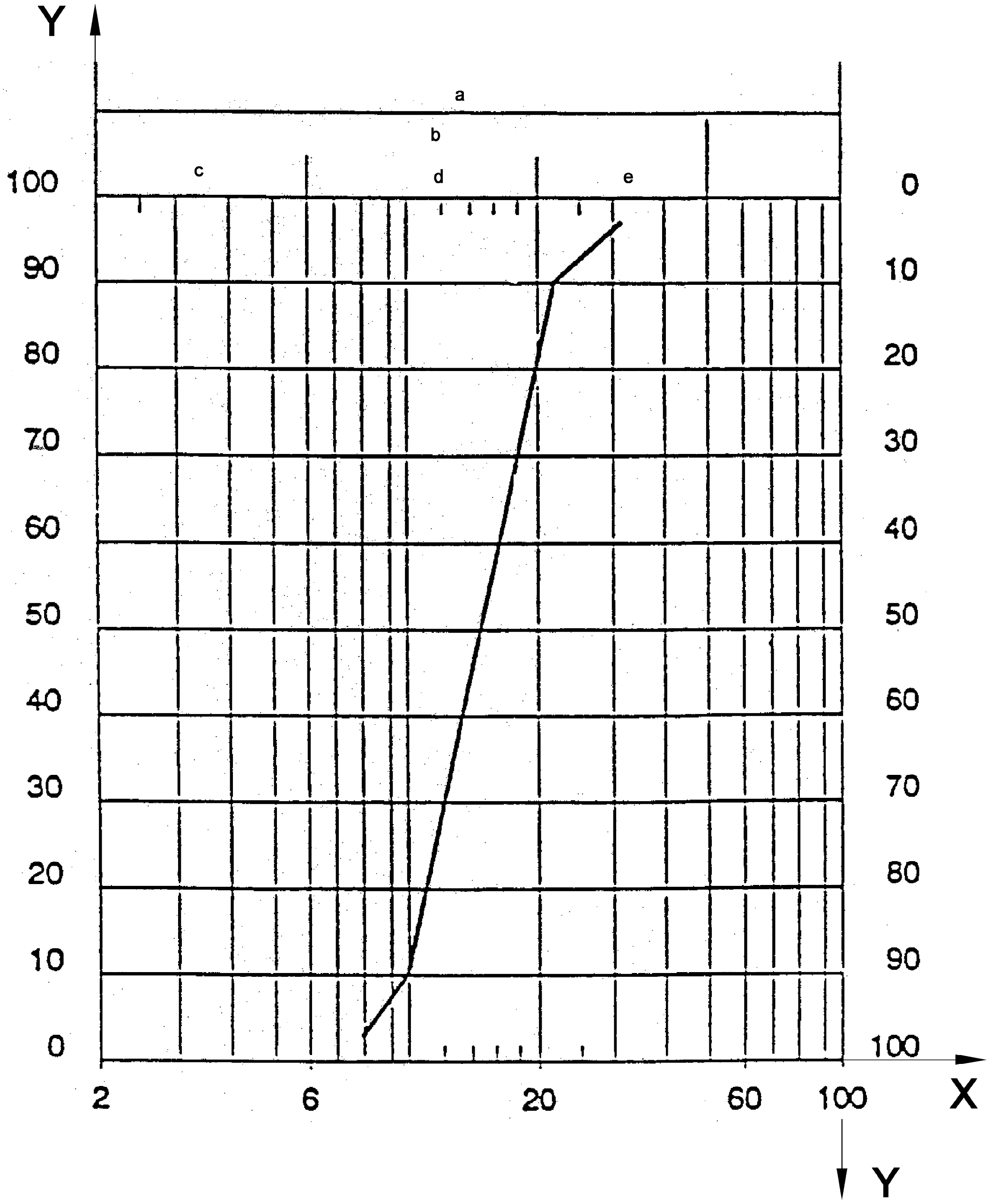


Key

AB	measuring length
A	start
B	end
2, 4, 6, 8, 10, 12	microphone positions for sound-power level determination
a	Gravel test course (depth = 0,50 m)
b	Hard reflecting plane 10 m × 10 m.
c	Plane without reflecting obstacles 25 m × 25 m.

Dimensions in metres

FIG. A.1 — TEST SITE AND ARRANGEMENT WITH TEST TRACK



Key

X percentage of mass of the total volume

Y grain size

a Screening gravel.

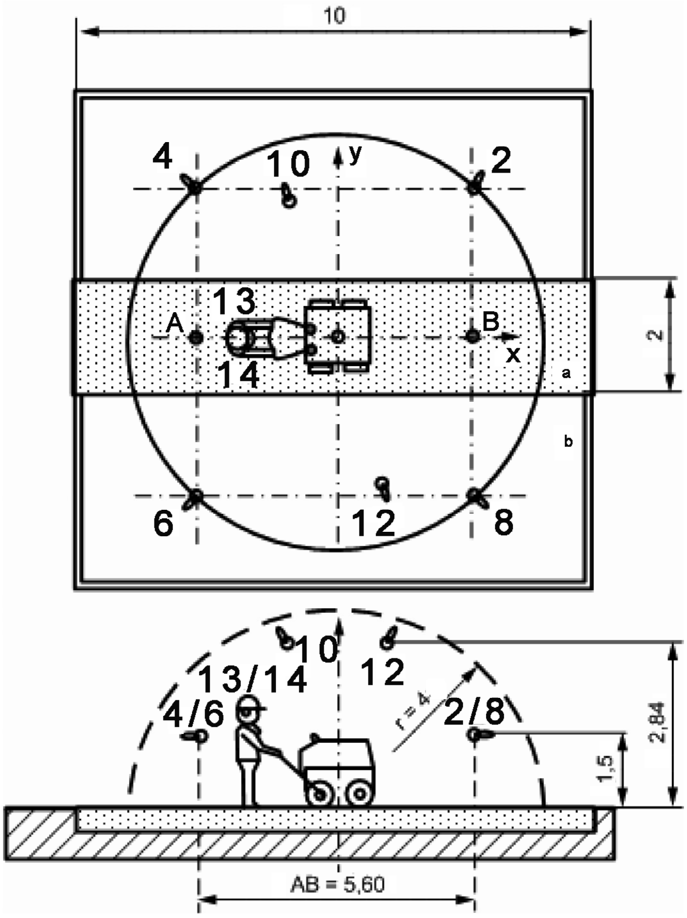
b Gravel size.

c Fine grain.

d Middle grain.

e Coarse grain.

FIG. A.2 — GRADING SIZE DIAGRAM OF THE MATERIAL TO BE COMPACTED (GRAVEL)



Key

AB	measuring length (AB = 5,60 m)
A	start
B	end
2, 4, 6, 8, 10, 12	microphone positions for sound-power level determination (*see* Table A.1)
13, 14	microphone positions for emission sound-pressure level determination
a	Gravel test course (depth = 0,50 m).
b	Hard reflecting plane 10 m × 10 m.

Measuring travel time, tF, calculated by

$$t_F = \frac{AB}{v_F}$$

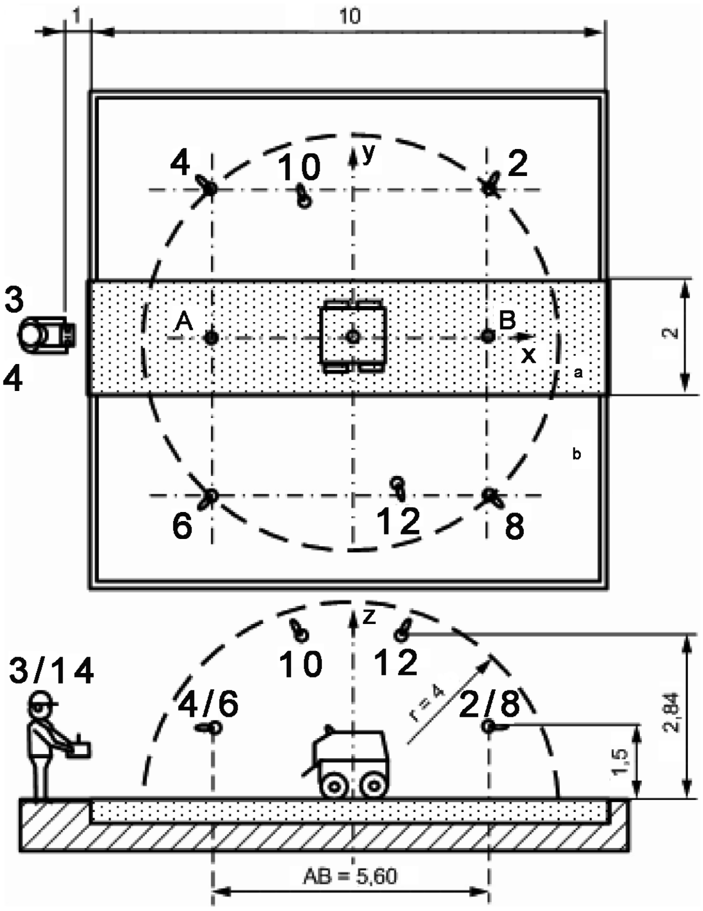
where

v_F is the working speed in m/s;

t_F = measuring time, t_M.

Dimensions in metres

FIG. A.3 — ARRANGEMENT OF TEST POSITIONS FOR DIRECT CONTROL NON-RIDING ROLLERS



Key

AB	measuring length (AB = 5,60 m)
A	start
B	end
2, 4, 6, 8, 10, 12	microphone positions for sound-power level determination (*see* Table A.1)
13, 14	microphone positions for emission sound-pressure level determination
a	Gravel test course (depth = 0,50 m).
b	Hard reflecting plane 10 m × 10 m.

Dimensions in metres

FIG. A.4 — ARRANGEMENT OF TEST POSITIONS FOR REMOTE-CONTROLLED ROLLERS

A-3.2 Test Procedure

A-3.2.1 *Operating Conditions*

For the measurements, the machine shall be in accordance with the manufacturer's specifications.

Water and fuel tanks shall be half-filled. The sprinkler facility shall not be switched on.

The drawbar of hand-guided machines shall be freely movable between the upper and lower stops.

The engine shall be at the rated speed (± 5 percent) as specified by the manufacturer.

The maximum forward working speed shall be selected. Ensure that the machine runs at the correct speed. The vibration setting that gives the highest noise contribution shall be selected.

Before starting the measurement, the operating temperature shall be reached.

A-3.2.2 *Test Track Preparation and Conditions*

The compacted material of the test surface shall be loosened before starting the whole test procedure. Test track material shall be dry. If it is wet or frozen this could influence the measurement result.

Machines with smooth drums could have difficulties running the first pass on the loosened track with vibrations. If that is the case, pre-compact the material by running over the track without vibrations.

The test track for remote-controlled rollers shall be identical to that of non-riding rollers (*see* Fig. A-1).

A-3.2.3 *Environment*

Air temperature should be above 10 °C.

A-3.2.4 *Measurement Procedure*

Simultaneous measurement at all microphone positions is preferred (it is also possible to perform consecutive measurements).

For the measurement duration, t_M, the surface of the test track AB = 5.60 m is compacted by the machine in forward operation. Subsequently, the machine is moved back to the starting point.

Start the measurement when the middle of the machine is in line with point A and stops at point B of the measuring stretch (*see* Fig. A-3 and Fig. A-4). In all cases, the compaction shall go on along the whole stretch of gravel. Therefore, it shall be ensured that the machine works with the full compaction power within the measuring distance.

For each machine, three passes over the test track shall be carried out. The completion of the three passes is considered as a measuring cycle.

The compacted material of the test surface shall not be loosened between the three passes.

The r.m.s. values of the sound-pressure levels shall be taken for each pass.

The machine shall be moved along the centreline of the test course as in usual operation.

The same person shall operate the machine during the whole test. That person shall be skilled in handling and operating the machine.

A-3.3 Calculation of the Sound-power Level

The A-weighted sound-power level is calculated as the arithmetic mean value of the three passes.

The A-weighted sound-power level of the machine shall be rounded down or up to the nearest integral value in decibels (<0.5 round down, ≥0. 5 round up).

A-3.4 Determination of Emission Sound-pressure Spectra

If required, sound-pressure spectra may be registered at microphone position 10 in accordance with ISO 3744.

A-4 DETERMINATION OF A-WEIGHTED EMISSION SOUND-PRESSURE LEVEL AT OPERATOR'S POSITION

A-4.1 General

This clause specifies additional requirements for the determination of the A-weighted emission sound pressure level of non-riding and remote-controlled vibratory rollers according to ISO 11201.

A-4.2 Test Procedure

The test shall be carried out in accordance with **A-3.2**.

For non-riding rollers, the position of the operator shall be as shown in Fig. A-3.

For remote-controlled rollers, the position of the operator shall be as shown in Fig. A-4.

Since the sound-pressure level varies in relation to the operator's height, this height shall be 1,80 m ± 0. 05 m.

NOTE — For a source with an A-weighted sound-power level of 100 dB situated 0. 3 m above the ground (centre of machine), the theoretical difference in A-weighted sound-pressure level between a position at 1. 5 m behind the source and 1.8 m above the ground (operator) and a position at 1. 5 m behind and 1. 6 m above ground (0,20 m shorter operator) is 0. 6 dB.

A-4.3 Calculation of the Emission Sound-pressure Level

The A-weighted sound-pressure level is calculated as the arithmetic mean value of the three passes.

The reported value is the highest of the two measurement positions (13, 14).

The A-weighted sound-pressure level at the operator's position shall be rounded down or up to the nearest integral value in dB (<0, 5 round down, ≥0, 5 round up).

A-4.4 Determination of Emission Sound-pressure Spectra

If required, sound-pressure spectra may be registered at the workstation in accordance with ISO 11201(microphone position 14, right ear, *see* Fig. A-3 and Fig. A-4).

A-4.5 Sound-pressure Level as Function of Time

If required, the sound-pressure level may be recorded as a function of time at microphone positions 10 and 14 (right ear).

A-5 UNCERTAINTY

The measurement uncertainty and, in the case of series machines, the uncertainty due to production variations shall be considered when determining the value of the A-weighted sound-power level and that of the A-weighted emission sound-pressure level at the operator's position.

Current experience shows that the total uncertainty (measurement plus production), *K*WA for the

A-weighted sound-power levels and *K*pA for the A-weighted emission sound-pressure level of non-riding and remote-controlled rollers is less than the values given in Table A-2.

Table A-2 Uncertainties

(*Clause* A-5)

*K*WA dB	*K*pA dB
1.0-2.0	2.0-3.0

A-6 INFORMATION TO BE RECORDED

ISO 3744 and ISO 11201 shall apply, with the following additions:

a) engine speed for each run;
b) vibration frequency for each run;
c) measurement duration, t_M, for each run;
d) height of the operating personnel;
e) grading curve of the gravel;
f) description of the test environment;
g) A-weighted sound-power level for each run and the resulting sound-power level as an emission value;
h) A-weighted emission sound-pressure level at the operator's position for each run and the arithmetic mean value (separately for left and right ear) of each;
j) sound-pressure spectra, where appropriate; and
k) sound-pressure level as a function of time, where appropriate.

A-7 INFORMATION TO BE REPORTED

Report all the information specified in **A-6**.

The test report shall include the statement that the sound-power level and the emission sound-pressure level at the operator's position have been determined entirely in accordance with the specifications of this annex.

A-8 DECLARATION AND VERIFICATION OF NOISE-EMISSION VALUES

The declared A-weighted sound-power level shall be the sum of the measured value and the associated uncertainty, *K*WA (*see* A-5).

NOTE — The declared value of the A-weighted sound-power level is identical to the guaranteed sound-power level according to the noise directive 2000/14/EC.

The declared A-weighted emission sound-pressure level at the operator's position shall be the sum of the measured value and the associated uncertainty, *K*pA (*see* A-5).

The noise declaration shall explicitly state that the noise-emission values have been obtained according to this noise-test code.

Verification shall be done using this noise-test code. If the value measured during verification is less than or equal to the declared value, the declared value shall be verified.

ANNEX B

(*Clause* 4.7)

TEST CODE FOR HAND–ARM VIBRATION OF NON-RIDING VIBRATORY ROLLERS WITH WORKING WIDTH ≤ 1 M

B-1 GENERAL

Specifications are laid down in Annex B for machines supplementary to ISO 20643 for non-riding vibratory rollers with a working width ≤ 1 m. These specifications serve to determine the characteristic vibration amplitudes under practical conditions. The machines are characterized by their possession of a module for producing vibration, so as to cause compacting of the ground.

This annex contains the same conditions for operation and arrangements as apply to the measurement of noise (*see* Annex A). It is therefore possible, and also preferable, to record the hand–arm vibration and the noise emission simultaneously during one measurement. This leads to a considerable reduction in the equipment required for testing the machine.

B-2 CHARACTERIZATION OF VIBRATION

B 2.1 Measurement Direction

The directions of measurement are shown in Fig. B-1. The coupling device shall be directed, depending on the size of the operator, such that the *z*-axis runs parallel to the ground during the measurements.

B-2.2 Measurement Location

The measurement position shall be located on the drawbar between two fingers, or as close as possible to the hand (*see* Fig. B-2). If the drawbar has a resilient cover, it is important that the hand be held on the transducer (coupling device), in order to avoid resonance phenomena.

B-2.3 Combination of Vibration Directions

The quantities to be measured are the r.m.s. values of the weighted vibration accelerations, $a_{xhw,i,}$ $a_{yhw,i,}$ $a_{zhw,i,}$ of the $i = 1$ to 3 measurements of a test run, in accordance with **A.4.2**. These are formed according to formula (B-1):

$$\bar{a}_{hwx} = \frac{1}{3}\sum_{i=l}^{3} a_{hwx,i}; \bar{a}_{hwy} = \frac{1}{3}\sum_{i=l}^{3} a_{hwy,i}; \bar{a}_{hwz} = \frac{1}{3}\sum_{i=l}^{3} a_{hwz,i} \qquad \text{(B-1)}$$

For each coordinate into the result of the test run.

The acceleration sum of the test run is formed according to formula (B-2):

$$a_h = \sqrt{\bar{a}_{hwx^2} + \bar{a}_{hwy^2} + \bar{a}_{hwz^2}} \qquad \text{(B-2)}$$

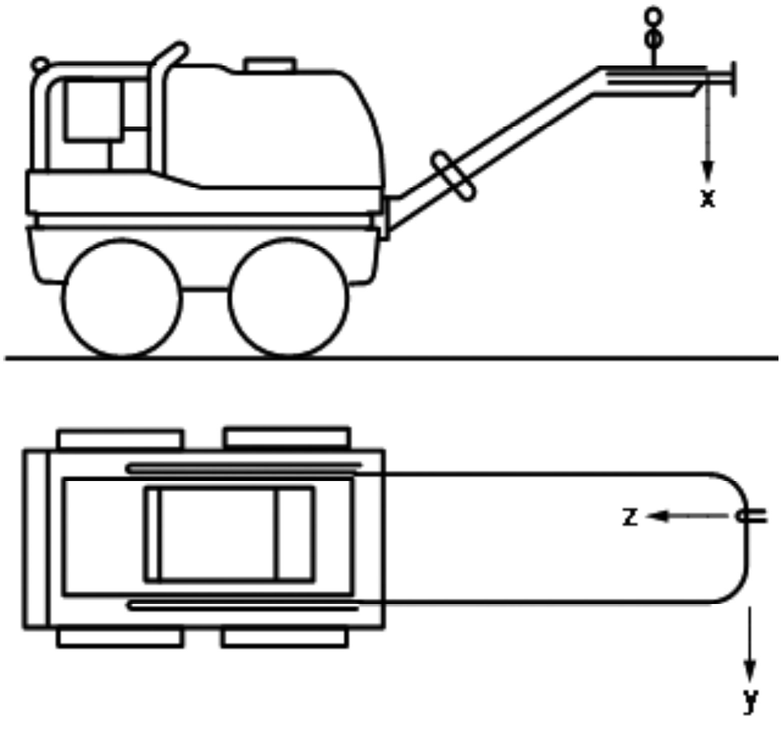
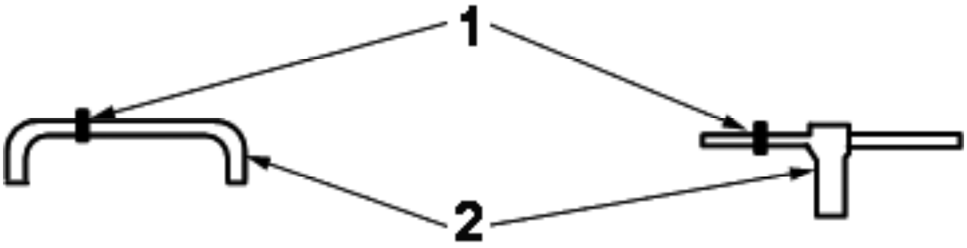


FIG. B.1 — DIRECTIONS OF MEASUREMENT



Key

1	coupling device
2	drawbar

FIG. B.2 — ARRANGEMENT OF COUPLING DEVICE ON DRAWBAR

B-3 INSTRUMENTATION REQUIREMENTS

B-3.1 Specification of Acceleration Transducer

The measurement is preferably done with a triaxial transducer, but may also be done with three separate transducers. The total mass of the transducers should be less than 60 g. The mass of the coupling device for the acceleration transducers should be kept as low as possible (maximum 60 g).

B-3.2 Mounting of Acceleration Transducer

Fasten the transducer rigidly to the drawbar with a coupling device. The coupling device shall be adapted to the diameter of the respective drawbar. Rigidly attach (screw or glue) the transducer to the coupling device.

The axes of the acceleration transducers shall be directed in accordance with **B-2.1**.

The acceleration transducer cables shall be pulled along by the machine or by the operator during measurement. Therefore, the cables shall be attached to the machine or the operator's waist, so that no tensile force develops at the acceleration transducers.

B-4 TEST PROCEDURE

B-4.1 General

Testing shall be in accordance with **A-4.2** and **B-4.2** to **B-4.4**.

B-4.2 Test Track

Unless simultaneous sound measurements are carried out, there are no requirements for the test site and background outside the gravel frame.

B-4.3 Operating Conditions

The machine shall be guided with both hands during measurement. Since the acceleration values measured at the drawbars can be influenced by the operating forces (gripping, feed, and guiding forces) exerted by the operator the following shall be applied:

a) a gripping force at the drawbar appropriate to typical operation;
b) a feed force at the drawbar appropriate to typical operation; and
c) a guiding force at the drawbar appropriate to typical operation.

NOTE — The three named forces cannot yet be measured by simple means according to the present state of the art.

B-4.4 Measurement Procedure

B-4.4.1 *General*

Record the signals in all three directions of measurement simultaneously.

B-4.4.2 *Calculation of Hand–arm Vibration Value*

Calculate the hand–arm vibration values in accordance with **B-2**.

B-4.4.3 *Frequency Analysis*

If required, frequency analyses from the acceleration time signals may be determined for one measurement direction (x-axis) or for all directions of measurement. The analyses shall not be weighted with the hand–arm filter.

B-4.4.4 *Time Records*

If required, the variations of the signals with time may be recorded for one measurement direction (x-axis) or for all three measurement directions.

B-5 INFORMATION TO BE RECORDED

ISO 20643 shall apply, with the following additions:

a) engine speed for each run;
b) vibration frequency for each run;
c) measurement duration, t_M, for each run;
d) drawbar height (from the ground maintained during the measurement;
e) grading curve of the gravel;

f) description of the test environment;

g) acceleration in the three directions for each run ($a_{hwx,i}$, $a_{hwy,i}$, $a_{hwz,i}$) as a weighted r.m.s. value; h) the arithmetic mean value of all runs for each measuring direction (a_{hwx}, a_{hwy}, a_{hwz}); j) the acceleration vector sum for each test cycle (a_{hv});

k) the acceleration vector sum of all measuring directions (a_h);

m) acceleration spectra, if appropriate; and

n) time records, if appropriate.

B-6 INFORMATION TO BE REPORTED

Report all the information specified in **B-5**.

The report shall include the statement that the vibration accelerations given fully comply with the requirements of this annex. The vibration accelerations shall be rounded to one decimal.

B-7 MEASUREMENT UNCERTAINTY

When applying this test procedure, a measurement uncertainty of 3 m/s^2 should be allowed for in the determination of the arithmetic mean values of the three vibration accelerations. The same applies to the sum of accelerations.

ANNEX C

ILLUSTRATIONS

See Fig. **C-1** and **C-2.**

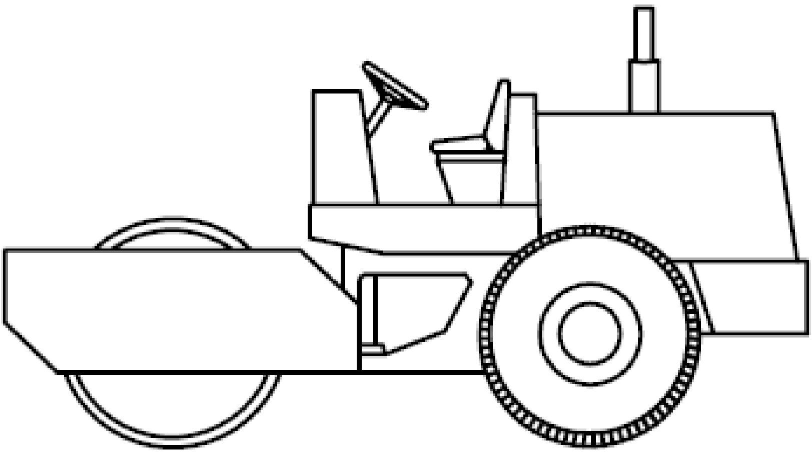


Fig. C.1 — Single-Drum, Dual-Wheel Roller with Pivot-Articulated Steering

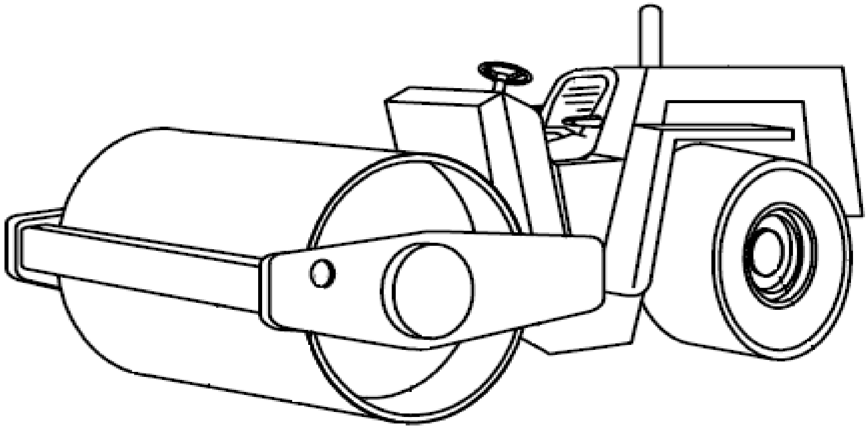


Fig. C.2 — Single Drum Dual Wheel Roller

See Figures **C.3** and **C.4**

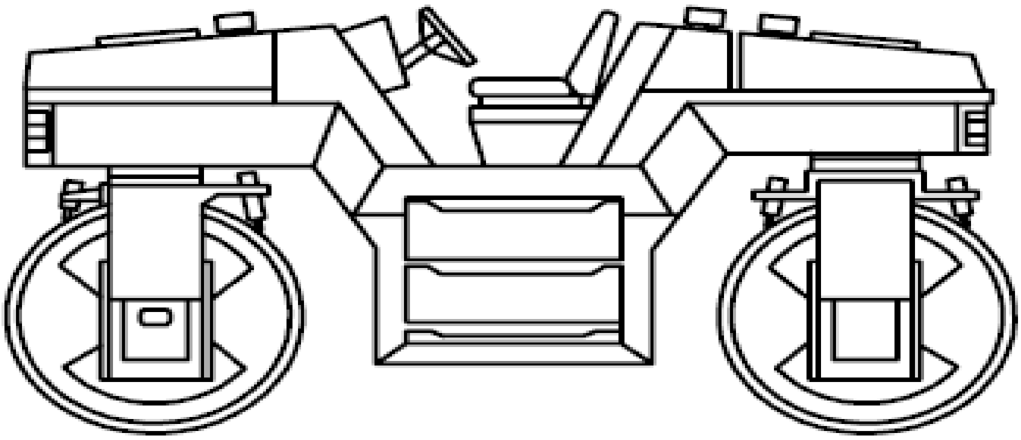


FIG. C.3 — DUAL-DRUM (OR) TANDEM ROLLER WITH CRAB-STEERING OR DRUM-OFFSET-STEERING HITCH

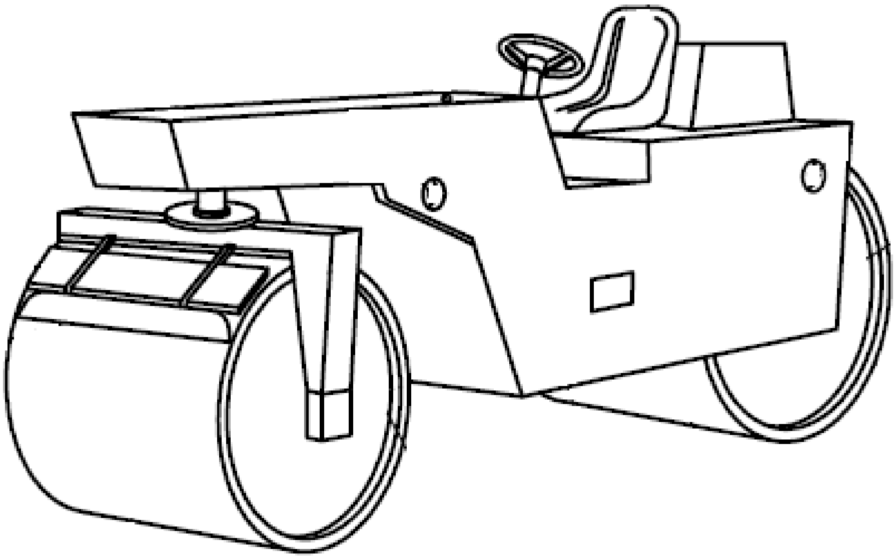


FIG. C.4 — DUAL-DRUM (OR) TANDEM ROLLER

see Figures **C.5**

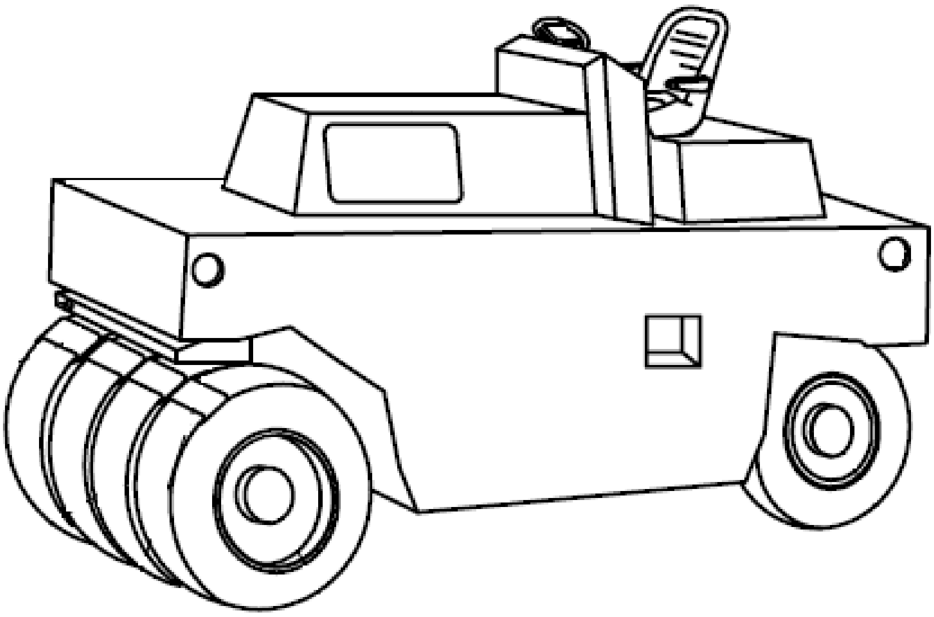


FIG. C.5 — PNEUMATIC-TYRED ROLLER

ANNEX D

(*Foreword*)

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